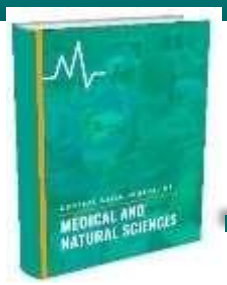
CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES



Volume: 04 Issue: 06 | Nov-Dec 2023 ISSN: 2660-4159

http://cajmns.centralasianstudies.org

A Protocol for The Biosynthesis of Nanoparticles by Plant Extracts

1. **Rana Tariq Yahya**
2. **Dalia Abdul Elah Mohammad**
3. **Amjad Abd Al-Hadi Mohammad**
4. **Marwan Zuhair Alias**

Received 20th Sep 2023,
Accepted 21st Oct 2023,
Online 8th Nov 2023

Corresponding author:
dalsbio121@uomosul.edu.iq

Abstract: The study summarized the most important biological methods in the manufacture of nanoparticles with high benefits, the most important of which is the vegetative or green biosynthesis of these nanoparticles using plant extracts and without side effects, as is the case in traditional methods.

Key words: Biosynthesis, nanoparticles, plant extracts.

Introduction

Nanobiotechnology are names that pointed to the connection of nanotechnology and biology (Ehud, 2007; Nussinov and Aleman., 2006; Raja, 2016). Nanomaterials have many applications in many scopes as environmental, food, remediation, agriculture and health care (Karp and Soccol., 2021).

General properties of nanomaterials (Saleh and Gupta, 2016): These nanoparticles have specific physical, chemical and biological characters paralleled to their big, which are largely to their structure and higher surface-area-to-volume percentage.

Types of nanoparticles (Khan et al., 2017; Crucho and Barros, 2017): Nanoparticles may be arranged into many categories according to the many physical features as size, morphology and chemical properties (Fig.1).

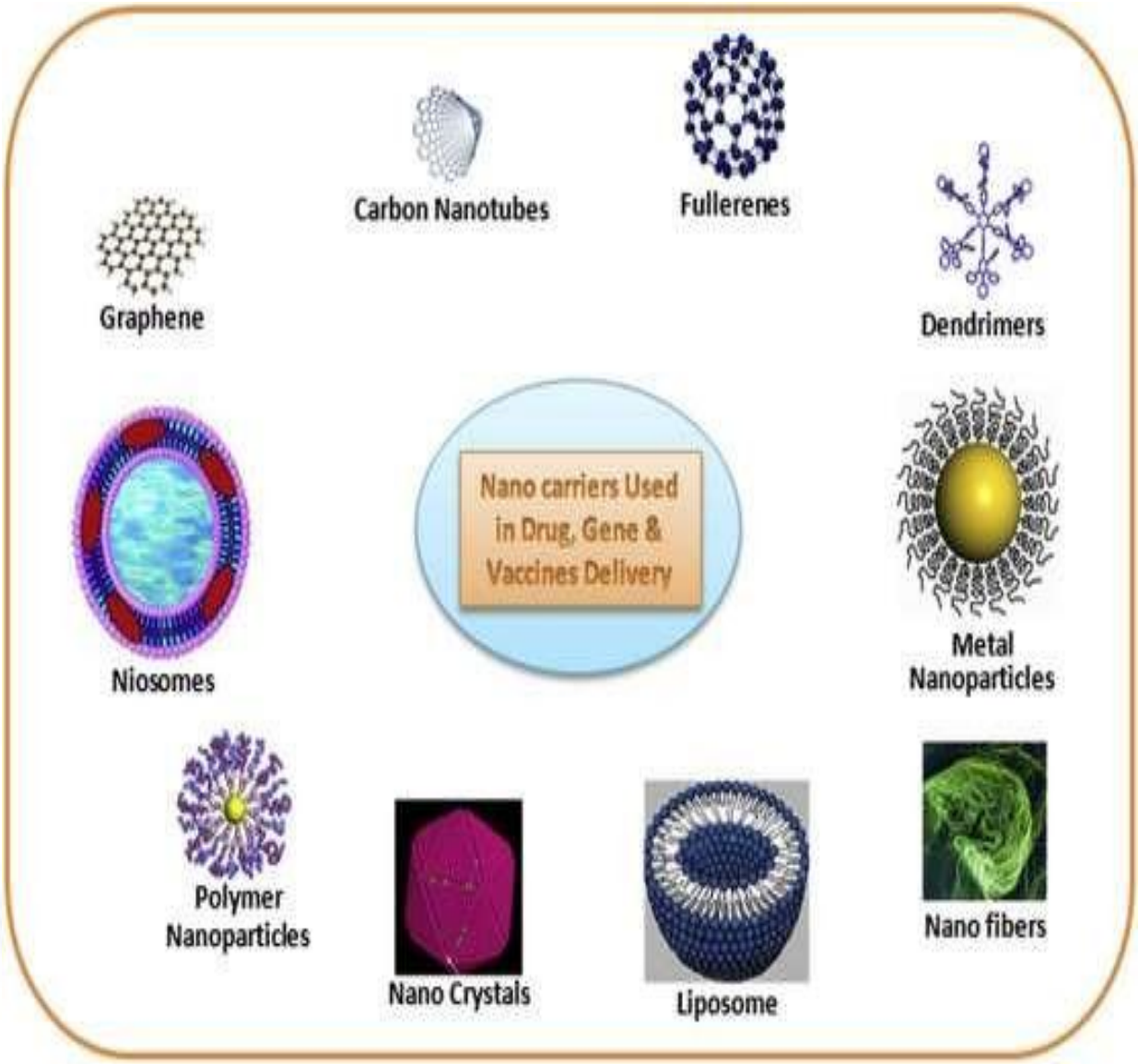


Figure. 1: Modern types of nanoparticles (Kumar et al., 2016)

Applications of nano biotechnology in agriculture

The engineered nanoparticles manipulated in the agriculture, containing herbicides and chemicals. Earlier Nano capsules containing herbicides have been described have the ability to enter across the outer layer of tissues, causing the gentle and produce of the medical compounds which minimize environmental pollution through agricultural. Several researches were pointed to the positive applicate of nanoparticles, which stimulate the growth of plants (Thangavelu et al., 2019). Nanoparticles based applications caused benefits compared to other nanoparticles found on different plant types with less toxicity (Thangavelu and Krishnan, 2016; Requal et al., 2009). AgNPs explain increased content of chlorophyll and ascorbate when they treated leaves of Asparagus. Also showed increased the vegetation length, leaf features, protein and chlorophyll contents of bean plant (Hediat, 2012).

Plant extract as a source of herbal medicine benefit of human health

They have aided as a benefit source of active materials for many pharmaceutical and many important medicines that have been isolation and characterized from plants. The end product of any isolation program is a drug, some type of pharmacological evaluation must necessarily be used to director the isolation methods to obtained the pure bioactive component (Kumar et al.,2017). The active substance content of plant extracts may different related to genetics of plants and to climatic features, the time of gathering and the extraction methods. Flavonoids may be somewhat accountable for their pharmaceutical effects. For examples extracts of Ginkgo biloba contain terpenes and flavonoids (Srivastava and Chaturvedi, 2014). Also, Centella asiatica extract are able to stimulate collagen synthesis in connective tissue (Ramelet., 2011; Dobrucka, 2019).

Synthesis of metal nanoparticles by plant extract

Today there are advanced study to manipulated of plant extracts in some fields as reductants and stabilizers to biosynthesis of them which has the functions of environmental friendliness, safe, and more constant in size than the supplements synthesis though the classical ways (Nune et al., 2009; Bao et al, 2021).

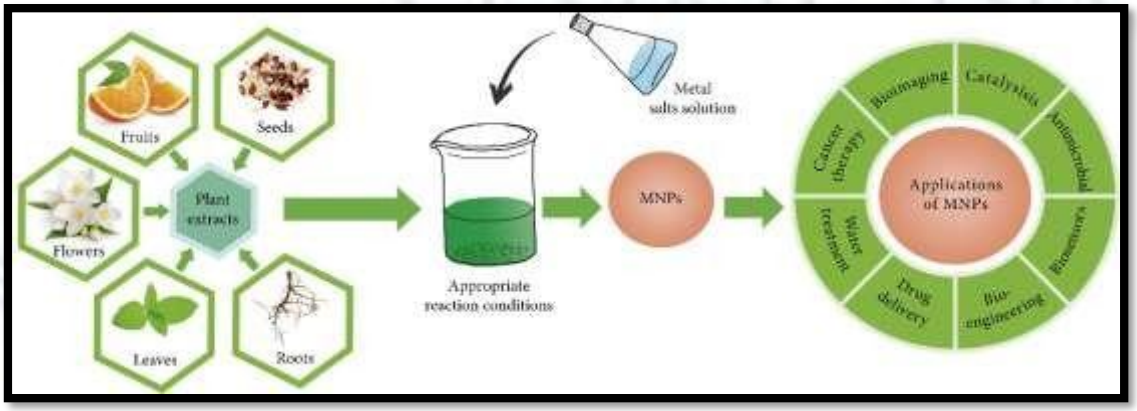


Figure. 2: Diagram for synthesis of metal nanoparticles by plant extracts (Yousaf et al.,2020).

Chemical mechanisms of using plant extract to synthesize metal nanoparticles.

Numerous active compounds as terpenoids, phenols, flavonoids, proteins, alkaloids and quinines found in plant extracts which have act as a reducing agent to produce MNPs also they have antioxidant properties (Veisi et al., 2019) thus act as a key in the green synthesis of them which can be represented by three phases : the reduction phase, growth phase, and termination phase (Naseer et al., 2020 ; Wang et al., 2021 Dinesh et al., 2020).

Examples of using plant extracts to synthesized nanoparticles:

Synthesis of silver nanoparticles:

They were synthesized using many types of extracts (Sundar et al., 2019; Pang et al., 2020; Yousaf et al., 2020). Jiang et al., 2016 prepare AgNPs through hawthorn fruits as reducing and stabilizing agents

to silver nitrate. Another study prepares AgNPs by used bark aqueous extracts of the Catharanthus roseus as the precursor compound to reduce silver nitrate (Nishanthi et al., 2019; Rohaizad et al., 2020).

- Synthesis of copper nanoparticles

It is an essential material and a main element of several enzymes and proteins. Today the researchers used copper nanoparticles (Cu-NPs) because they have many advantages as easy accessibility, not expensive and good catalytic features (Chandra et al., 2014, Zhao et al.., 2020) which enable it to be commonly used in biomedicine and solar energy conversion (Chen et al., 2012 ; Das et al., 2020). Pinto et al., 2019 used a Eucalyptus globulus bark extracts to prepare CuNPs by reduce copper chloride dihydrate. Many studies proved the ability to prepare CuNPs through reduced copper salts by used several extracts of flower, leaf, seed, fruit, and bark (Sajadi et al., 2016; Adhikari, 2019).

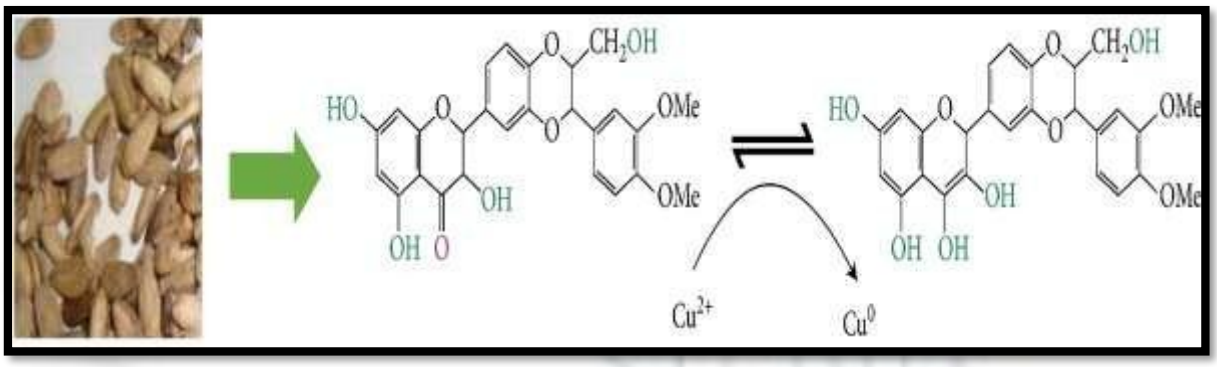


Figure 3: Mechanism of Cu-NP synthesis using Silybum marianum L. seed extracts (Sajadi et al., 2016)

Aim of the study

Recently, the plant-extract-proposed the specialized ways for the preparation of MNPs, that suitable to the application fields to aid us in better use this green synthesis method.

References

1. Adhikari, R. (2019). Advances in the oligonucleotide-based sensor technology for detection of pharmaceutical contaminants in the environment. In Tools, Techniques and Protocols for Monitoring Environmental Contaminants,125-146
2. Bao, Y. ; He,. J. ; Song, K. ; Guo. J. ; Zhou, X. and Liu, S.(2021). Plant-Extract-Mediated Synthesis of Metal Nanoparticles. Advanced Catalysis and Synthesis for Sustainable and Environmental Processes.
3. Chen, Y. ; Wang, D.; Zhou, X. ; Zheng , X. A. and Feng , L.(2012). Long-term effects of copper nanoparticles on wastewater biological nutrient removal and N2O generation in the activated sludge process., Environ. Sci. and Technol.,46(22):12452–12458.
4. Chandra. S; Kumar. A. and Tomar. P. K. (2014). Synthesis and characterization of copper nanoparticles by reducing agent, J. Saudi Chem. Soc., 18(2): 149–153.

5. Crucho, C. I. C. and Barros, M. T. (2017). Polymeric nanoparticles: A study on the preparation variables and characterization methods. Materials Sci. and Eng., 80:771-784.
6. Dobrucka, R. (2019). Biofabrication of platinum nanoparticles using Fumariae herba extract and their catalytic properties, Saudi J. Biol. Sci., 26(1):31–37.
7. Dinesh. G. K. ; Pramod. M. and Chakma. S.(2020). Sonochemical synthesis of amphoteric CuO-nanoparticles using Hibiscus rosa-sinensis extract and their applications for degradation of 5-fluorouracil and lovastatin drugs, J. Hazardous Materials, 399: 123035–123048.
8. Das, P. E. ; Abu-Yousef, I. A. ; Majdalawieh. A. F. ; Narasimhan. S. and Poltronieri, A. (2020). Green synthesis of encapsulated copper nanoparticles using a hydroalcoholic extract of Moringa oleifera leaves and assessment of their antioxidant and antimicrobial activities, Mol., 25(3): 555–571.
9. Din, I. ; Arshad ,F. ; Hussain, Z. and Mukhtar. M. (2017). Green adeptness in the synthesis and stabilization of copper nanoparticles: catalytic, antibacterial, cytotoxicity and antioxidant activities, Nanoscale Res. Lett., 12(1): 638–652.
10. Ehud, G.(2007). Plenty of Room for Biology at the Bottom: An introduction to bionanotechnology. Distributed by World Scientific Publishing Co. Pte. Ltd.
11. Hediat, S.M.H.(2012).Effects of silver nanoparticles in some crop plants, common bean (Phaseolus vulgaris L.) and corn (Zea mays L.). Internat. Res. J. Biotech., 3(10): 190–197.
12. Jiang, Y. ; Li, F. and Liu, C.(2016). Biosynthesized silver nanoparticles using hawthorn fruit extract and their antibacterial activity against four common aquatic pathogens., Oceanologia , 47(1):253–260.
13. Kumar, B. ; Smita, K. ; Debut, A. and Cumbal, L.(2016). Extracellular green synthesis of silver nanoparticles using Amazonian fruit Araza (Eugenia stipitata McVaugh).Transactions of Nonferrous Metals Society of China.,26(9): 2363–2371.
14. Kumar, P. ; Kim, K. H. ; Bansal, V. ; Kumar, S. ; Dilbaghi, N. and Kim, Y.H. (2017). Modern progress and future challenges in nano carriers for probe applications. TrAC Trends in Analytical Chemistry, 86:235-250.
15. Khan ; Ibrahim ; Khalid S. and Idrees, K.(2017).Nanoparticles: Properties, applications and toxicities. Arabian J. Chem., 12(7): 908-931.
16. Karp, S. G. and Soccol, C. R. (2021). Lignocellulosic biorefinery for value-added products: The emerging bioeconomy. Biomass, Biofuels, Biochem., 291-321.
17. Nasrollahzadeh, M. ; Sajjadi, M. and Sajadi, S. M.(2019). Green synthesis of Cu/zirconium silicate nanocomposite by using Rubia tinctorum leaf extract and its application in the preparation of N-benzyl-N-arylcyanamides. Appl. Org.Chem.,33(2) :4705–4717.
18. Naseer, A. ; Ali, A. and Ali. S.(2020). Biogenic and eco-benign synthesis of platinum nanoparticles (PtNPs) using plants aqueous extracts and biological derivatives: environmental, biological and catalytic applications. J. Materials Res. and Technol., 9(4):9093–9107.
19. Nishanthi, R. ; Malathi, S. ; John P. S. and Palani, S.(2019).Green synthesis and characterization of bioinspired silver, gold and platinum nanoparticles and evaluation of their

synergistic antibacterial activity after combining with different classes of antibiotics, Materials Sci. Eng.,96:693–707.

20. Nune, S. K ; Chandra , N. ; Shukla, R. and Katti, K. (2009).Green nanotechnology from tea: phytochemicals in tea as building blocks for production of biocompatible gold nanoparticles. Materials Chem., 19(19) :2912–2920.
21. Nussinov, R. and Aleman, A.(2006) . Nanobiology : from physics and engineering to biology. Physical Biol., 3(1).
22. Pang, Z. ; Li, H. ; Liu, J. ;Yu, G. and He, S.(2020). Nano-silver preparation using leaf extracts of Youngia japonica and its inhibitory effects on growth of bacteria from cut lily stem-ends. Northern Horticul.,14: 103–109.
23. Pinto, R. J. B. ; Lucas, J. M. F. and Silva, F. M.(2019). Bio-based synthesis of oxidation resistant copper nanowires using an aqueous plant extract., J. Cleaner Production., 221:122–131.
24. Raja. (2016).Effect of deoxycholate capped silver nanoparticles in seed dormancy breaking of Withania somnifera. Pdf Current Sci., 116 :952.
25. Ramelet, A. A. (2011).in Sclerotherapy treatment of Varicose and Telangiectatic Leg Veins, Fifth Edition, 88-87
26. Requal. B ; Eudad. C ; Joan, C. ; Xavier. F ; Antoni, S and Victor, P. (2009). Evaluation of the ecotoxicity of model nanoparticles. Chemosphere., 75(7):850-857.
27. Rohaizad, A. ; Shahabuddin, S. ; Shahid, M.M ; Rashid, N. M ; Hir, Z. A. M ; Ramly, M. M. ; Khalijah, A. ; Song, C. W. and Aspanut, Z. (2020).Green synthesis of silver nanoparticles from Catharanthus roseus dried bark extract deposited on graphene oxide for effective adsorption of methylene blue dye.Environ.Chem. Eng. 8(4): 103955–103964.
28. Saleh, T. A. and Gupta, V. K. (2016). An overview of membrane science and technology. Nanomaterial and Polymer Membranes Synthesis, Characterization and Applications:1-23.
29. Srivastava, P. and Chaturvedi, R.(2014). Herbal Medicine and Biotechnology for the Benefit of Human Health. Animal Biotechnology Models in Discovery and Translation:563-575.
30. Sajadi, S. M ; Nasrollahzadeh, M. and Maha, M. (2016). Aqueous extract from seeds of Silybum marianum L. as a green material for preparation of the Cu/Fe3O4 nanoparticles: a magnetically recoverable and reusable catalyst for the reduction of nitroarenes., J. Colloid and Interface Science, 469: 93–98.
31. Sundar, S. ; Kim, K. J. and Kwon. S. J. (2019). Observation of single nanoparticle collisions with green synthesized Pt, Au and Ag nanoparticles using electrocatalytic signal amplification method. Nanomaterials., 9(12):1695–1707.
32. Thangavelu, R.M. and Krishnan, K.(2016). Nanobiotechnology approach using plant rooting hormone synthesized silver nanoparticle as “nanobullets” for the dynamic applications in horticulture – An in vitro and ex vitro study. Arab. J. Chem., 11(1):48-61.

33. Thangavelu, R.M. ; Munisamy, B. and Krishnan, K.(2019). Effect of Deoxycholate Capped Silver nanoparticles in seed Dormancy Breaking of Withania Somnifera. Current Sci., 116:952.
34. Veisi, H. ; Kavian, M. ; Hekmati, M. and Hemmati, S.(2019). Biosynthesis of the silver nanoparticles on the graphene oxide's surface using Pistacia atlantica leaves extract and its antibacterial activity against some human pathogens. Polyhedron.,161: 338–345.
35. Wang, X. ; Yua, Y. ; Deng, H. and Zhang, Z.(2021). Structural characterization and stability study of green synthesized starch stabilized silver nanoparticles loaded with isoorientin. Food Chemistry.,338:127807–127809
36. Yousaf, H. ; Mehmood, A. ; Ahmad, K.S. and Raffi. M.(2020).Green synthesis of silver nanoparticles and their applications as an alternative antibacterial and antioxidant agents, Materials Sci. Eng., 112:110901–110907.
37. Zhao, H. ; Su, H. ; Ahmed, A. ; Sun, Y. ; Li, Z. ; Zengeneh, M. M. ; Nowrozi, M. ; Zengeneh, A. and Moradi, M.(2020). Biosynthesis of copper nanoparticles using Allium eriophyllum Boiss leaf aqueous extract; characterization and analysis of their antimicrobial and cutaneous wound- healing potentials, Applied Organometallic Chemistry.